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than of a general nature. This is especially obvious in the treatment of such diseases as apple rust and pear blight. The illustrations are poor. Such figures as 29, 32, 40, 69, 76, 83, 86, 92, 98 are not worthy of publication. Throughout the book there is a tendency to present various conflicting theories and arguments concerning a given disease, with the result that often the real conclusions, if any, are buried or obscured. This really is the result of the status of pathology, of insufficient knowledge of the diseases in question, but the value of such presentation to the student and especially to the practical grower is doubtful. Assuming a central New York viewpoint and interest, the book may be said to give a very complete presentation of what is known of fruit diseases, with valuable lists of references to original sources of information. It is, as the authors announce, the first American text to deal wholly with diseases of fruits, and here for the first time are brought together with comprehensive discussion many obscure and little-known diseases. The facts presented are well selected, and the book constitutes a valuable addition to the literature of plant diseases.

—F. L. STEVENS.

North American Flora.—The second part of Vol. 21 contains the presentation of Amaranthaceae by STANLEY,⁴ who recognizes 166 species distributed among 21 genera. *Amaranthus* is much the largest genus, with 42 species, followed by *Iresine* with 32, *Achyranthes* with 31, and *Gomphrena* with 15. These 4 genera contain 120 of the 166 species, the remaining 46 being distributed among 17 genera. New species, 10 in number, are described in *Amaranthus* (4), *Acnida*, *Froelichia*, *Achyranthes*, *Gomphrena* (2), and *Iresine*.—J. M. C.

North American Flora.—The second part of Vol. 10 contains the presentation of Agaricales by MURRILL,⁵ including the subtribe Pluteanae. The largest genera are *Entoloma* (63 spp.), *Pluteus* (57 spp.), and *Leptoniella* (43 spp.). Ten genera are presented, and 109 new species are distributed as follows: *Claudopus*, *Eccilia* (9), *Leptoniella* (14), *Nolanea* (11), *Pleuropus* (7), *Entoloma* (34), *Pluteus* (30), *Chamaeota*, and *Volvariopsis* (2).—J. M. C.

NOTES FOR STUDENTS

Anthocyanins.—Since the review of the anthocyan (anthocyanin) pigments by CROCKER,⁶ much of interest from the chemical point of view has appeared. As pointed out by CROCKER, these facts are of marked significance to all botanists. Students interested in the general problems of anthocyanins (botanical, chemical, and genetic) will find much of value in Miss WHELDALE's book.⁷

⁴ STANLEY, PAUL C., North American Flora 21:part 2. pp. 95-169. (Chenopodiaceae) Amaranthaceae. New York Botanic Garden. 1917.

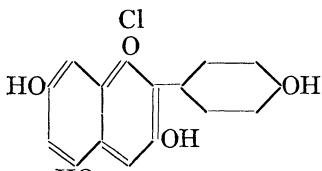
⁵ MURRILL, W. A., North American Flora 10:part 2. pp. 77-144. Agaricales: Agaricaceae (pars); Agariceae (pars). New York Botanic Garden. 1917.

⁶ CROCKER, WM., BOT. GAZ. 61:349. 1916.

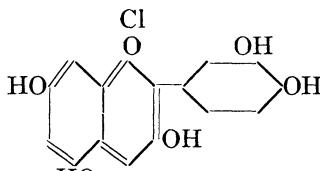
⁷ WHELDALE, M., The anthocyanin pigments of plants. Cambridge University Press. 1916.

The bibliography is very complete and should stimulate further work. Brief reviews of the anthocyan pigments have recently appeared by ATKINS,⁸ EVEREST,⁹ WHELDALE,¹⁰ TRUTTWIN,¹¹ and WEST.¹²

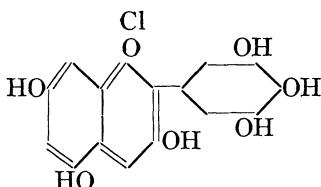
The constitution of the anthocyanidins (the sugar-free compound, obtained upon hydrolysis of the anthocyan with 20 per cent hydrochloric acid) has been definitely established by the synthesis of cyanidin (by the reduction of quercetin with magnesium at 35°),¹³ and of pelargonidin (in which phloroglucinic aldehyde was the starting point).¹⁴ These syntheses prove the correctness of the formulas earlier proposed by WILLSTÄTTER, after studying the physical and chemical properties of the anthocyanidin chlorides. The mechanism of the reduction of quercetin and other flavones to anthocyanidins has been questioned by certain Japanese workers,¹⁵ who claim to have isolated various magnesium compounds as intermediate products. These criticisms, however, in no way invalidate the general conclusion as to the structure of the anthocyanidins.



Pelargonidin chloride



Cyanidin chloride



Delphinidin chloride

⁸ ATKINS, W. R. G., *Researches in plant physiology*. Whittaker Co. 1916.

⁹ EVEREST, A. E., *Science Progress* 9:597. 1914-15; *Jour. Genetics* 4:367. 1914-15.

¹⁰ WHELDALE, M., *Jour. Genetics* 4:109, 369. 1914-15.

¹¹ TRUTTWIN, HANS, *Chem. Zeit.* 40:478. 1916.

¹² WEST, CLARENCE J., *Register of Phi Lambda Upsilon* 6:1-18. 1917.

¹³ WILLSTÄTTER, R., and MALLISON, H., *Sitz. Ber. Akad. Wiss.* 12:769. 1914.

¹⁴ WILLSTÄTTER, R., and ZECHMEISTER, L., *Sitz. Ber. Akad. Wiss.* 12:886. 1914.

¹⁵ SHIBATA, K., SHIBATA, Y., and KASIWAGI, I., *Jour. Pharm. Soc. Japan* no. 417. 1916; *Chem. Abstr.* 11:578. 1917.

The amyl alcohol test for anthocyanins has played an important part in the course of WILLSTÄTTER's work. The anthocyan (glucoside) remains quantitatively in dilute (2 N) sulphuric acid when shaken with amyl alcohol, whereas the anthocyanidin (non-glucoside) passes quantitatively into the alcoholic layer, yielding a red solution. When shaken with a solution of sodium acetate the red color becomes violet or violet red, the pigment remaining quantitatively in the amyl alcohol. On shaking with sodium carbonate, the alcohol solution turns blue or bluish-green, and at the same time the pigment descends quantitatively into the aqueous layer.

This is true only for diglucosides. Monoglucosides yield a certain amount of the pigment to the amyl alcohol. Rhamnose glucosides (containing one molecule each of rhamnose and glucose) behave like the monoglucosides. From this it is seen that the test may be used to distinguish nomo- and rhamnose-glucosides from diglucosides.

The test is also of service in testing the individuality of anthocyan. For this the acid used must be of sufficient concentration to prevent the conversion of the colored chloride into the colorless carbinol (ψ base) and yet must be dilute enough to dissolve the chloride readily (0.5 per cent hydrochloric acid is recommended). The solutions must be very dilute on account of the limited solubility of the coloring matter in amyl alcohol. The intensity of the color of the amyl alcohol solution is compared with that of the anthocyan chloride. Two successive extractions with amyl alcohol are made, and the fraction of the anthocyan in the extracts, called the "partition number," should be the same in both cases.

WILLSTÄTTER's first work indicated that the flower and fruit pigments might fall into 3 classes, depending upon whether the sugar-free component was pelargonidin, cyanidin, or delphinidin. The possibility of the other classes was not excluded, but they were not found. The second series of papers would seem to confirm this.¹⁶ Here, also, only pigments belonging to one of these three classes were found. It is true that the possibility of other classes is, again, not excluded. Indeed, WILLSTÄTTER states in the article on the poppy that the preliminary work on different varieties of this flower has indicated that the isolation of several new anthocyanidins may be expected. The one flower studied, however, was found to contain cyanidin.

Table I gives the pigments thus far isolated and studied, together with the formula of chloride, the source from which it was isolated, the anthocyanidin resulting on hydrolysis and the sugar component. They are divided into the 3 classes mentioned.

¹⁶ WILLSTÄTTER, R., Untersuchungen über die Anthocyane. XI (with BOLTON, E. K.). *Ann.* 412:113. 1916; XII (with BOLTON, E. K.). *Ibid.* 136; XIII (with BURDICK, C. L.). *Ibid.* 149; XIV (with ZOLLINGER, E. H.). *Ibid.* 164; XV (with WEIL, F. J.). *Ibid.* 178; XVI (with ZOLLINGER, E. H.). *Ibid.* 195; XVII (with BURDICK, C. L.). *Ibid.* 217; XVIII (with WEIL, F. J.). *Ibid.* 231.

The relationships of these various anthocyanins and anthocyanidins may best be seen from the diagrams on page 259.

TABLE I

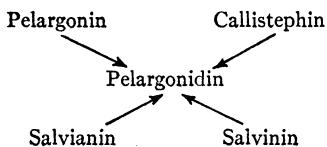
Anthocyan	Formula	Anthocyanidin	Occurrence	Sugar components
Pelargonidin group				
Pelargonin	$C_{27}H_{31}O_{15}Cl$	Pelargonidin	Scarlet red pelargonium, corn-flower, orange red and dark violet dahlia	2 glucose
Callistephin	$C_{21}H_{21}O_{10}Cl$	"	Summer aster	1 "
Salvianin		"	Scarlet red salvia	2 "
Salvinin	$C_{27}H_{31}O_{15}Cl$	"	Salvia	2 "
Salvin	$C_{27}H_{27}O_{13}Cl$	"	Salvia	
Cyanidin group				
Cyanin	$C_{27}H_{31}O_{16}Cl$	Cyanidin	Cornflower, rose, dark red garden dahlia	2 glucose
Idaein	$C_{21}H_{21}O_{11}Cl$	"	Whortleberry	1 galactose
Chrysanthemin	$C_{21}H_{21}O_{11}Cl$	"	Chrysanthemum	1 glucose
Asterin	$C_{21}H_{21}O_{11}Cl$	"	Summer aster	1 "
Keracyanin	$C_{27}H_{31}O_{15}Cl$	"	Cherry	Glucose and rhamnose
Prunicyanin	$C_{27}H_{21}O_{15}Cl$	"	Black thornberry	Rhamnose and a hexose
Mecocyanin	$C_{27}H_{31}O_{16}Cl$	"	Poppy	2 glucose
Peonin	$C_{28}H_{33}O_{16}Cl$	Peonidin*	Peony	1 "
Delphinidin group				
Delphinin	$C_{41}H_{39}O_{21}Cl$	Delphinidin	Larkspur	2 "
Violanin		"	Pansy	Rhamnose and glucose
Enin	$C_{23}H_{23}O_{12}Cl$	Enidin*	Grapes	1 glucose
Malvin	$C_{29}H_{35}O_{17}Cl$	Malvidin*	Wild mallow	2 "
Myrtillin	$C_{22}H_{23}O_{12}Cl$	Myrtillidin*	Bilberry	1 "
Althaein	$C_{22}H_{23}O_{12}Cl$	" *	Hollyhock	1 "
Petunin	$C_{28}H_{33}O_{17}Cl$	Petunidin*	Petunia	2 "
Ampelopsin	$C_{22}H_{23}O_{12}Cl$	Ampelopsidin*	<i>Ampelopsis</i> (wild grapes)	1 "

* Mono—or dimethyl ethers.

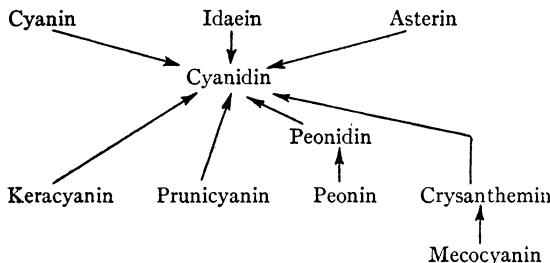
A study of table I shows the remarkable distribution of each group. Thus, cyanidin glucosides have been isolated from the following sources: the blue corn flower contains 0.7 per cent of the dry weight of the flower, while the Bordeaux red variety contains 13–14 per cent; 2 per cent of the dry weight of the rose (commercial *Rosa gallica*) and 20 per cent of the dark red garden dahlia are cyanin. Cyanidin has also been isolated from the chrysanthemum, the summer aster, the poppy, and the peony. Varying amounts of cyanidin glucosides are found in the following: *Zinnia elegans* Jacq., *Gaillardia bicolor* Hook., *Helenium autumnale* L., *Gadiolus* (the scarlet varieties of which contain a pelargonidin glucoside), *Tulipa Gesneriana* L., *Tropaeolum majus* L., *Ribes*

rubrum L., the raspberry, and the berry of the mountain ash. These glucosides also occur very extensively in fruits and in yellowish red, red, brown, and dark blue berries. They have been isolated from the cranberry, the cherry, the sloe (black thornberry), and the plum. The occurrence of a pure red coloring

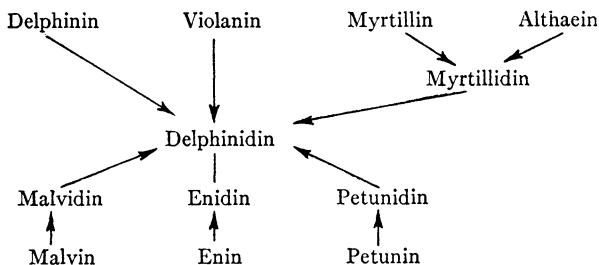
Pelargonidin group



Cyanidin group



Delphinidin group



matter in the bluish black skins of such fruits is remarkable. Some explanation has to be found as to how cyanidin is able to impart such deep colors to fruits. The other groups show almost as wide a distribution as does the cyanidin group.

The conclusion that the color of the flower depends, in part, upon the reaction of the cell sap seems to need some modification, in view of the work of

HAAS¹⁷ on this question. Determination of the total acidity and actual acidity by means of titration, and the gas chain and buffer solutions, shows that the reaction of the cells studied ranges from about $P_H + 3$ to $P_H + 7$. If we call the buffer solution acid up to $P_H + 7$, neutral when at $P_H + 7$, and alkaline when higher than $P_H + 7$, it is evident that it is unsafe to call cell sap acid when red, neutral or alkaline when blue, and markedly alkaline when green, unless the color changes of the particular pigment are first studied by some method, such as that of using buffer solutions of known hydrogen ion concentration.

One other study may also be mentioned in this connection. These chemical investigations inspired a study by SHIBATA, NAGAI, and KISHIDA¹⁸ of the physiological and biological significance of the anthocyanins and flavones in plants. The evidence obtained established a somewhat unexpected fact, namely, that the flavone derivatives are one of the cell contents of very common occurrence in the plant kingdom. In fact, they are quite as common as chlorophyll, tannins, sugars, starches, and proteins. They are not only found in the yellow coloring matter, but also in the cell sap of the epidermis and in the underlying tissue of plants in general. In only a small number of plants is a complete absence of chromogen proved; for example, in the white corn flower (*Centaurea cyanus*), oxalis (*Oxalis violacea*), pink (*Dianthus caryophyllus*), and pelargonium (*Pelargonium cucullatum*). The function of the flavone derivatives dissolved in the cell sap is to protect the living protoplasm and the important biochemical agents involved from the injurious action of the ultra-violet rays of sunlight by absorbing them at the peripheral layer of the plant organism. The plausibility of this assumption is justified by an extensive study of the flora of alpine and tropical regions. The green leaves of deciduous trees, which produce anthocyan pigments in autumn, contain a considerable amount of flavones. The production of autumnal color is due to the biochemical change, that is, the reduction of already existing flavones in the leaf, initiated by the physiological condition at the end of the growing season, without having special ecological significance.

This brief survey of recent progress in anthocyan chemistry makes it seem very probable that in the near future we may have a complete classification of these pigments, based upon accurate and definite knowledge of the chemical structure of the substances involved. It is to be hoped that the work may make substantial progress in spite of the war.—CLARENCE J. WEST.

Taxonomic notes.—EVANS¹⁹ has published a monograph of the North American species of *Marchantia*, recognizing 9 species, one of which (*M. breviloba* of Jamaica) is new. The extensive discussion of species is preceded

¹⁷ HAAS, A. R., Jour. Biol. Chem. **27**:233. 1916; BOT. GAZ. **63**:232. 1917.

¹⁸ SHIBATA, K., NAGAI, I., and KISHIDA, M., Jour. Biol. Chem. **28**:93. 1916-17.

¹⁹ EVANS, ALEXANDER W., The American species of *Marchantia*. Trans. Conn. Acad. Sci. **21**:201-313. figs. 20. 1917.